DOCUMENT RESUME

ED 272 182 IR 012 270

TITLE	Bringing Ideas to Reality: Technology in Our Schools. Proceedings of a Regional Invitational Forum (2nd, Orlando, Florida, 1985). Schooling and Technology, Volume 5.
INSTITUTION	Southeastern Regional Council for Educational Improvement, Research Triangle Park, N.C.
SPONS AGENCY	National Inst. of Education (ED), Washington, DC.
PUB DATE	Nov 85
NOTE	37p.; For volume 4 of this series, see ED 261 465.
PUB TYPE	Collected Works - Conference Proceedings (021) -- Viewpoints (120) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Computer Assisted Instruction; *Computers; *Educational Change; Educational Innovation; Educational Principles; Educational Trends; Elementary Secondary Education; *Teacher Role; *Technological Advancement; *Telecommunications

ABSTRACT

This report summarizes a conference sponsored by the Southeastern Regional Council for Educational Improvement which explored issues related to the purposes, roles, and practices of the schools in regard to the new technologies. After a brief introduction, Part 1 focuses on strategies for integrating various technological approaches into the curriculum, e.g., computers, electronic art, computer assisted instruction, and electronic networks. Use of technology in school management is also discussed. Part 2 discusses future uses of technology in tomorrow's schools, addressing possible changes in the structure and functions of schools, the role of the teacher, problems that may be caused by the implementation of electronic learning, the challenges of staff development, and the question of copyright. Part 3 briefly describes three paths that educators may follow: (1) the full exploration of the creative and effective uses of electronic technologies in the instructional process and in school management activities; (2) the use of computers to assist in the instructional process, but without making changes in the curriculum to accommodate the computer; and (3) anticipation of far-reaching changes in the curriculum and public education caused by technology and rethinking the purpose of education accordingly. A list of participants and presenters at the conference is included. (JB)

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Bringing Ideas to Reality: Technology in Our Schools

Schooling and Technology Series • Volume 5

Southeastern Regional Council for Educational Improvement

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The activities reported in this publication were supported, in whole in in part, by a grant from the National Institute of Education. U.S. Department of Education. However, the opinions expressed here do not necessarily relfect the position or policy of the U.S. Department of Education, the Southeastern Regional Council for Educational Improvement member states' departments of education, or their chief state school officers.

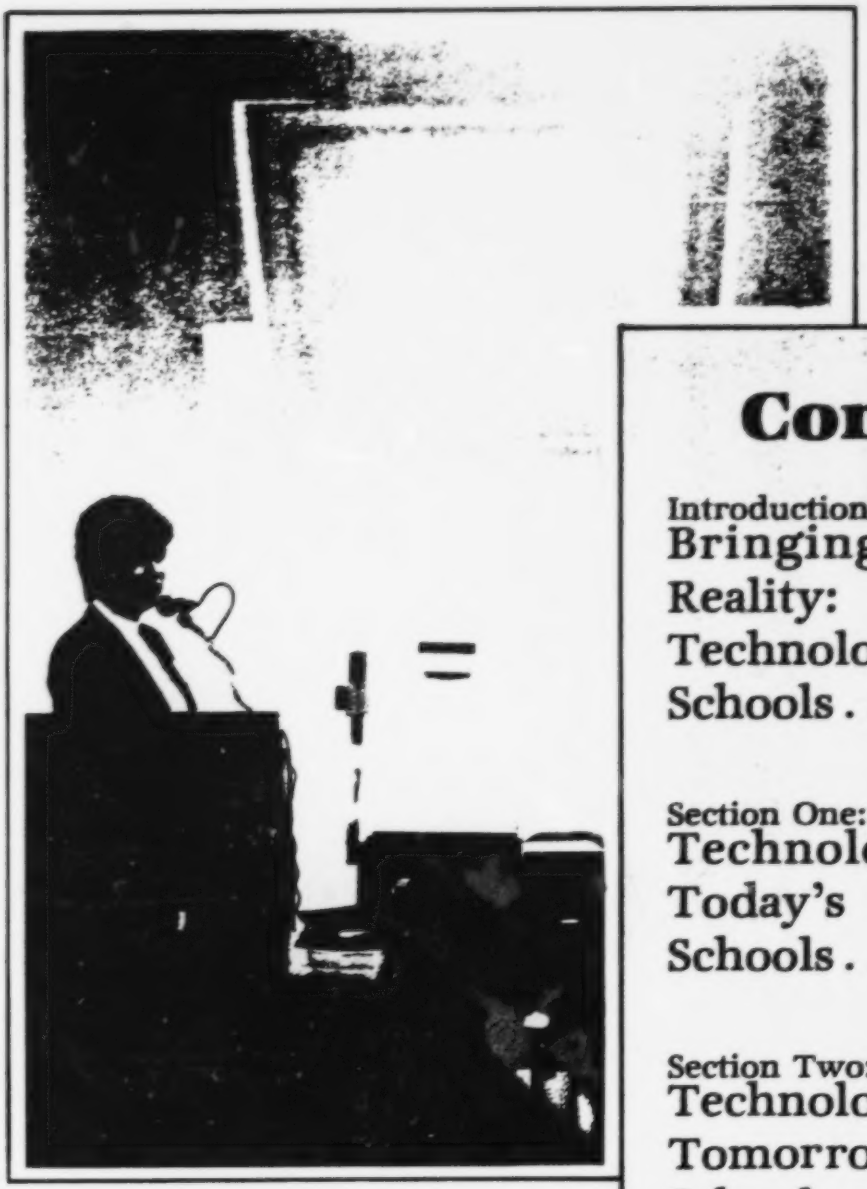
Schooling and Technology Series

Volume 5

Bringing Ideas to Reality: Technology in Our Schools

November 1985

Southeastern Regional Council for Educational Improvement



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Introduction

Bringing Ideas to Reality: Technology in Our Schools

Four years ago, fewer than half of the nation's school *districts* owned a computer; today over 80 percent of the school *buildings* have at least one. In fact, well over a million microcomputers were used for instruction in 1985. Educators are discovering that they are confronting more than just the problem of acquiring hardware. Schools are faced with numerous problems, challenges, and opportunities. In short, "You don't just plug the computers in."

Problems as basic as rewiring and as complex and subtle as redefining curricular goals must be dealt with. Some of the challenges—scheduling, for example—were anticipated; others, like defining copyright, were not. Perhaps, above all, educators are discovering that bringing computer technologies into the schools means change—anticipated and not, positive and problematic. That, at least, was the message when 100 invited regional educators gathered in Orlando, Florida, earlier this year to share their experiences in "Bringing Ideas to Reality."

The conference was the second such forum sponsored by the Southeastern Regional Council for Educational Improvement, and it reflected implementation activities that schools and states are undertaking to bring technology to the region's schools. At the first forum, in 1983, the invited state and local school educators, university representatives, and educational policy makers met to consider the implications of integrating computers (and other electronic tools) into the schools. For many, the discussion was somewhat hypothetical. Although there was a sense of excitement about what computer technology *could* mean, few school systems in the region had much experience with it—particularly on an instructional level. Thus, the discussions in 1983 focused on policy issues: teacher and student competencies in computer education, computer literacy, networking, software considerations, and developing state leadership.

Two years later, some of the faces were the same, but the chemistry had changed. There was a noticeably sharper, clearer sense of purpose; conversations seemed less tentative. The change that had overtaken these educators was clear: they were no longer a group of the simply technologically "literate"; they were *experts* who were moving the technology in many different ways to improve schooling for students. Supported by a variety of state and local initiatives and through a good measure of trial and error, these educators brought to the forum not just ideas for the future, but realities: sophisticated, statewide data collection programs; electronic communications networks; creative software and administrative applications of computer technology; and—most importantly—many innovative and demonstrably effective ways of using

the technology to strengthen the teaching-learning process.

Thus, the Orlando conference served, in effect, as a classroom—a forum where these educators could share the lessons learned in their efforts to bring technology into the schools. And share they did. Over the course of the two-and-a-half-day meeting, conferees offered and absorbed a wealth of information—from advice on how to use computers for grade reporting to cautions about copyright violations.

Running throughout the discussions was recognition that, in addition to the practical, straightforward problems that must be overcome to introduce technology into the schools, educators face a number of critical, as yet unresolved, issues:

Staff Development and Certification

Of all these issues, none is more vital than staff development: preparing teachers to understand and use computers and other technologies in ways that best serve students. Nicholas Hobar of West Virginia observed that a "major issue of implementation" of electronic technologies in schools is "whether or not it's a job requirement." If it is not, then implementation will be uneven at best. A related policy issue is the variety of certification requirements that are being adopted or proposed by states in the region—from general encouragement to teachers to have at least a single course in "computer literacy" to, in other instances, stringent evidence of competence.

Determining what level of competence teachers must acquire to understand and use electronic technology in the schools is at the heart of a series of important, often difficult, questions confronting educators. State and local staff development programs and both teacher education and inservice activities gain focus and direction when there is agreement on purpose. Certification requirements, proponents say, can provide that shared purpose.

Accountability

Florida's Education Commissioner, Ralph D. Turlington, raised a key policy issue when he noted that technology provides the opportunity to increase education's accountability to the general public by measuring outcomes in far more comprehensive ways than has been possible in the past.

"We can use this type of information as a tool for stimulating support," he said, "and also for stimulating ourselves. When people know you're keeping score and watching—and you can do that in very positive ways, in my judgment—it can have enormous effect on motivation and success. At any rate, it's at the heart of the strategy we have underway here in Florida. I believe it will work."

At the same time, conferees acknowledged the growing problems of accountability in an information age: the proliferation of information and educational sources, changing perceptions of "basic" skill requirements, and reporting concerns. It is clear that pressures for using technology to increase accountability, from within education and without, will raise new, complex issues for education policy makers.

Successful Reform

The Council's Executive Director, Charles J. Law, Jr., challenged policy makers to move in new ways in an effort to engage people in the process of change at the grass-roots level. The failure of many educational reform movements, he noted, has roots in the difference between imposition and involvement. "The simple truth is, people need and want to be involved in formulating changes that affect their destiny," said Law. "When that opportunity is denied or limited, we may be sure there will be great resistance to reform and change." Policy makers are challenged to find ways to make full use of the new technologies through a process that fully engages those who will be asked to use them, he suggested. Evidence that this is occurring in the various states is uneven.

Appropriate Tools

As much as the technology has developed in recent years, it needs to change even more, these experts agreed. It is time, they said, that hardware and software be developed specifically to address the needs of education. This places an obligation on policy makers to ensure that educators who are technologically skilled—few in number, but growing—are engaged fully in the planning process.

This report offers, in summary form, much of the thinking and discussion presented in Orlando. Its purpose was suggested by the conferees: to share two distinct, but closely related, kinds of lessons. The first of these, summarized in Section I, are the practical lessons with immediate application. Much has been learned in the last two years about using electronic technologies to improve instruction and school management, and conferees were happy to share the benefits of their own efforts—from warnings about pitfalls to recommended shortcuts.

In Section II, the focus shifts somewhat toward the future. For, even as they compared notes on CAI and networking configurations, conferees acknowledged that "introducing technologies into the schools" had important—and often unexpected—long-term implications as well. While "today's" problems were difficult, they agreed, "tomorrow" offered greater challenges still. At one end of the spectrum were the concerns expressed by keynote speaker Mary Alice White, who urged conferees to "recognize how these new technologies will impact upon the schools . . . and how they will change the role of school in society." At the other end loom more specific and immediate concerns about training staff and dealing with copyright laws in an age of electronic communications.

Section One:

Technology and Today's Schools

Local Initiatives to Promote Technology

"When the idea of computers for our school was first broached, some years ago, the first authoritative response was, 'That's a foolish idea.' When interest persisted, and the idea surfaced again, we were told, 'Well, it may be okay, but the time is not right.' Then when some people actually began using computers and the idea refused to go away, we heard, 'Yes, it's a good idea, but we can't afford it.' Finally, when computers began arriving in our school, we heard the comment, 'Of course I was always in favor of it anyway.'"

That story prompted laughter and many nodding heads among the educational technology pioneers in the Orlando conference room. While facetious, it also was a familiar experience for most conferees. The real point of the story is that local-level initiative, by an individual or small group, has most often been the catalyst in introducing computers into schools. Interest and pressure from parents has perhaps been the second most influential factor in spurring interest in computer education over the last four or five years.

However, while there are similarities in the experiences of educators who have taken steps into the computer age, there also are significant differences—and those were shared in the remarks of three "electronic educators" as they recalled how computers moved into their schools. The implementation patterns were the same: a search for funding, adoption of purposeful guidelines, training of teachers (the most complex step, all agreed), and, finally, bringing computer and student into one-on-one contact. But, while the developmental pattern was the same, the method of accomplishment was different for each system.

The "electronic educators" holding center stage in Orlando represented small- to medium-sized districts in Alabama, West Virginia, and North Carolina. Collectively, Herbert Alexander, Marilyn Stone, and Judy LeCroy made these key points, honed by their experiences:

- Introducing computers into schools is a complicated business, replete with unexpected problems, ranging from temperature control and the potential need to rewire classrooms to overcoming the resistance expressed by many teachers.
- Yes, it's true: Computers do enhance learning for students, or at least that's the view of these educators working "in the electronic trenches" since 1980. As one said, "Computers in our school have had a positive impact on student life. Kids come to school early and leave late because they're interested in learning. Computers have improved public interest in and support for our schools and strengthened our relationship with the public." Computers, in sum, are getting high marks from these educators for helping education do its job.
- The key to getting results is the training and involvement of teachers. These districts are using a variety of inducements that are working: arranging for substantial purchase discounts on computer hardware and software for teachers who wish to own their own machines; working with area teacher training institutions to establish credit courses in computer instruction; encouraging teachers to borrow computers to take home over weekends and holidays; involving teachers in establishing guidelines for the use of computers on various grade levels and for purposes such as

special education, industrial arts, and vocational education; and arranging no-cost summer training experiences for teachers who want them. Not surprisingly, teachers respond with interest and enthusiasm to such overtures. That is a principal reason, said these three educators, that they can report on success stories in their districts.

◆ While funding may be a difficult issue, these educators have obtained support from many different sources, including parent-teacher organizations, state grants programs, and federal program funding for the disadvantaged.

◆ The single greatest problem expressed by these educators is the need for additional computers. The elementary school in Welcome, North Carolina, has ten machines for 800 students. One computer is designated for each grade level and is shared by four to five teachers, and one is used for special education. "The goal—and the very real need—is to have one computer for every *classroom*," said Media Coordinator Judy LeCroy. Raleigh County School District in West Virginia got an early start in the computer business and thus has become a pilot program for the state, reported Marilyn Stone, and now has about 650 computers available for use by 18,000 students—the best computer-to-student ratio in the state. Reporting for the small district of Medfield, Alabama, Herbert Alexander agreed he would like to increase substantially the number of computers that he has configured into a series of lab settings.

◆ The three educators—including Principal Alexander—agreed that the involvement, interest, and support of the building principal is *the* crucial ingredient in successful implementation of technology into schools. Without it, chances of success are remote at best, they agreed.

As a closing comment, Judy LeCroy noted there's still a place for humor even when dealing with something as potentially threatening (as it is perceived by many) as a computer. At the conclusion of training programs with teachers, she said, a "Certificate of Achievement" is awarded to participants. "It has become one of the most coveted awards in the district" by teachers who clearly understand they will never be replaced by something as literal and dumb as a computer. The certificate reads: "*We have not succeeded in answering all your questions. Indeed, we sometimes feel we have not completely answered any of them. The answers we have given only serve to raise a whole set of new questions. In some ways we feel that you are as confused as ever, but we believe you are confused on a much higher level and about more important things.*"

Integrating Computers into Content Areas

Listen for a moment to North Carolina's Doc McCulloch, the state education department's consultant for art education:

"I take great pride in art teachers. They are willing to take risks. So I'm not surprised that it was in art education that we established one of the first instructional models for the use of computer technology. Of the twenty-three teachers involved, only two had any familiarity with computers. Collectively, they said they wished they had not entered the program, because it forced them to unlearn so much of what they knew and made them start over with a fresh point of view."

Computers have a way of doing that: challenging traditional thinking, insisting upon clarity, rationality, logical thinking. Even in the arts.

McCulloch was among the North Carolina representatives speaking about the integration of new technologies into the content areas in their state—specifically, in the arts, vocational education, and writing. Their collective experiences and extremely positive outcomes proved valuable models for the conferees.

Technology and the Arts

North Carolina's continuing "Electronic Art" program began in 1983-84 in six elementary, eight middle/junior high, and nine secondary schools. More than 3,500 students participated, "and they came early and left school late," said McCulloch. "Attendance improved and drop-outs declined in all of the programs."

Each participating school purchased a computer and recommended software (total cost: about $4,500) for exclusive use in the art room. The program was eclectic, reaching out to high- and low-achievers, the gifted and talented, and special education students.

"The role of the students became an important component to the success of this project," said McCul-

loch. "They were encouraged to become actively involved in the training processes necessary for the art teacher and other peers." During the year, additional training was offered to the teachers. "We found it difficult to keep up with them," said McCulloch. "A lot is determined by the teachers themselves. At the end of the year, more than half of the teachers decided they wanted to attend additional training courses. We found that space, time, and access to the equipment are important—because the computer truly is a personal tool." There were other findings, as well:

◆ Hardware and software choices are of critical importance. Touch pads, a desktop mouse, light pens, and graphic tablets proved to be invaluable. But there are still real limitations. "The computer, great as it is, is still a machine that needs improvement. It's not the machine we need in education," said McCulloch. "We need to design a different tool. Not only do we need different courseware, but we may need different hardware to be applicable to the different courses. Right now the same machine shows up in any instructional area. In art we may need something a little different than in language arts. The other side of that coin is that we as educators are trying to adapt our traditional instructional methodology to a new tool. We need to work on both of those issues."

◆ The State Department of Public Instruction built a network system into the project that proved to be "a major factor in ensuring success. When anyone had a problem, he or she could immediately locate someone with solutions."

◆ Technology was used to teach traditional art concepts applicable in the various media. One important outcome, said McCulloch, "Our attention became focused on the realization that electronic art is a new art medium and deserves to be explored in its own right." *(See box.)*

The program has been such a success in North Carolina that curriculum components are being designed to ensure that the computer becomes integrated into the art education program in every school. "Every aspect of electronic art will be explored within the state curriculum," said McCulloch.

Further, with the help of state education experts, many of the 21 teacher training institutions in the state that offer certification tracks in art education are in the process of developing a component in electronic art for their students.

Electronic Art in North Carolina

Art and computers make an interesting mix:

◆ Traditional art concepts can be taught through the use of computers, and then applied to a variety of media.

◆ A significant application is the understanding that electronic art is the newest wave affecting the art world. It is, in itself, a legitimate art form—the art of the 21st century.

◆ True integration of all the other art areas can be possible to the user. Dance, drama, music, and visual art can be composited into one singular media display. The user controls other elements such as sound, movement, and color.

◆ Linked with the videodisc systems, the computer becomes an extensive teaching tool for art appreciation/history instructions that allow the student to interact with computer assignments.

—Doc McCulloch
Consultant, Art Education,
North Carolina
Department of Public Instruction

Vocational Education

"Give a kid a hammer, and everything becomes a nail. Give all teachers a computer, then everything must be taught with a computer." With that kind of approach, says June Atkinson, "computers are quietly stashed in closets, computer labs remain empty, and money is spent for tools that are not being used."

At the heart of using computers for instructional purposes, she says, are answers to a series of questions. What will this tool help us do? Will it help us achieve positive results? In terms of time and cost, will we be able to achieve results with computers that we could achieve no other way? And in vocational education we need to ask another question: Will these tools help us prepare students for the job market?

In North Carolina, the answer to that last question clearly is "yes." As early as 1979, educators were talking with people in business and industry to establish priorities for computer instruction with a vocational orientation. "We asked them to look at our curriculum, tell us what was outdated and should no longer be taught, what competencies could best be taught on the computer, and what kinds of tasks computers were performing in the marketplace."

Accounting emerged as a top priority for a model program, and businessmen and educators again sat together to review software programs and formulate program objectives. "Next, we carefully selected eight business educators and gave them thorough training with computers and the selected software programs. They, in turn, held a series of workshops throughout the state for accounting instructors.

"Our objective, really, was to create unrest among the accounting teachers. We wanted these teachers to perceive the computer as an important new tool in their discipline and to be highly motivated to gain expertise in its use—as rapidly as possible." The strategy worked. An electronic network now links accounting teachers throughout the state, as they continue to gain experience in using computers to teach accounting.

Vocational educators in North Carolina engaged in similar processes as they introduced computer instruction into business and office education, health occupations, home economics, agriculture education, industrial arts, marketing and distributive education, vocational development, and trade and industrial education. A key step, in every instance, has been collaboration between content and media specialists in designing the most effective ways to provide students with computer skills and engage them in computer-assisted instructional activities and skillful use of resources in the private sector.

Writing with Computers

Michael Fry offered three concepts that have proved their value in North Carolina for effective use of computers in teaching writing:

- Be sure that the teacher understands the equipment and knows how to operate it. The teacher must understand how microcomputers aid in writing.
- Have the teacher train five or six students to use the equipment and software. These students will require a substantial amount of practice time on the computer in order to have a full understanding of its potential usefulness in the writing process.
- Have these students help train the remainder of the class by demonstrating the hardware and software, answering questions, and supervising small groups of students as they practice on computers.

Computers and Writing

It was Dorothy Parker who said, "I hate to write. I love to have written." Michael Fry of the North Carolina state education agency reports that "by using computers, we're able to get students to that 'I love to have written' stage a lot more easily."

A five-step computer program for improving the writing skills of fifth graders has experienced notable success. The steps are prewriting, including research; drafting (the "no fear, no consequence" approach); revision; proofreading; and publishing. "While the necessary software will depend on the age of the students and their level of skill development," said Fry, "the four pieces of hardware that are essential include the computer, a monitor, one disk drive, and a printer."

Prewriting activities include choosing a topic, deciding what form to use in writing about that topic, and completing research. Teachers are actively involved with students in completing these steps, encouraging them to go beyond traditional printed references as they learn more about their subjects. They sometimes view films and videotapes, even tap into database services via modem.

In the drafting stage, teachers encourage students to write down their ideas freely, with little concern for errors in spelling, punctuation, or grammar. Draft work is usually done at the computer. Teachers are equally involved in the process of revision and editing, finding it a particularly useful time to work with students to strengthen skill areas. Tutorial and drill-and-practice-

programs, as well as educational games, often are used for this purpose. These activities lead to a final editing of the student's paper.

Multiple copies of the finished work are printed for distribution to other students and for display on bulletin boards. Dorothy Parker probably would agree with Fry's comment that "students find writing much more rewarding when they know others will be reading what they have written."

Summarizing this successful program, Fry made these observations: "We found that using a computer is fun. Kids are used to it, it's like an arcade game. There was no reluctance to become involved. What we were surprised and delighted to find out is that students will commit words more easily to a microcomputer than they will to a piece of paper. There's something less permanent about putting writing in a machine when you know you can go back and correct it.

"Computers can do things that humans cannot, at least as well, and that makes them exciting tools in developing communications skills. They're fast—much faster than humans. They're flexible. They're infinitely patient. They are accurate, and they'll do exactly what they've been told to do. They're probably the only thing in the universe that truly follows directions."

Major Statewide Programs for CAI

Every state education agency in the region is working with local districts to encourage effective use of technology. Most use advisory groups or statewide commissions to conduct studies and formulate guidelines. Where the legislatures become active in the issue and provide funding, more even development throughout a state is likely to occur. Such was the case in two of the region's states—Arkansas and Tennessee—whose two very different developmental paths were shared with conferees.

Two top executives raised $300,000 over breakfast one morning to launch Arkansas' public schools into the computer age. Tennessee doubled its sales tax to improve basic and computer skills. These represent examples of the various funding patterns that states have undertaken to provide comprehensive, ambitious statewide electronic technology initiatives in education. Purposes and objectives of the statewide activities were different in important respects.

Project IMPAC in Arkansas

Responding to fund-raising efforts of the president of a major utility and the head of a large computer software company, the legislature established the Arkansas Commission on Microcomputer Instruction in 1983 to conduct a two-year applied research program, with funding of $2.5 million.

A professional staff of seven headed by Cecil McDermott has made Project IMPAC (Instructional Microcomputer Project for Arkansas Classrooms) live up to its name. "Part of my job," said McDermott, "has been to survey the literature. Since 1962, there has been

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extensive research done that we can't afford to overlook in education. It says a lot of things to us about how to create an unbalanced curriculum real quick with new innovations." *(See box).*

Based on staff research, the Commission developed a program and called for applications. "It's a three-year ride," said McDermott. "We pay all the expenses, but it's a research and development program. It involves pretesting, posttesting, and so on."

Eighty-nine schools applied for participation in the program. The 22 selected "represent the students more than the size of schools. We're a rural state, so we went where the children are. There are a number of medium-sized and large districts involved."

The programs were described as "nothing earthshaking; just a good, basic introduction to CAI/CMI. We, by the way, have not spent a single dollar on computer literacy in grades K-8. Our state is not involved in computer literacy at all. It was the first decision made by the Commission."

Research on CAI

Project IMPAC's major research review on computer-assisted instruction produced "seven generalizations about CAI with enough regularity to inspire confidence in their use," said IMPAC Director Cecil McDermott:

- CAI is most successful in helping learners attain clearly specified objectives, especially in the basic skills areas.
- CAI saves a significant amount of time over "conventional instruction," as much as 20 to 40 percent.
- Retention rates following CAI are at least as good as, and often better than, retention following conventional instruction.
- Students have positive attitudes toward good CAI programs and dislike poor programs, especially those over which they have no control.
- The appropriate instructional time for CAI from both a learner and administrative standpoint is 12-20 minutes on task four days a week in a given subject.
- Tutorial-drill-practice CAI are effective types of courseware. Courseware incorporating both Behavioral and Gestalt psychological principles increase effectiveness.
- Achievement gains in reading are about 70 percent of the gains in mathematics when instruction is supplemented with basic skills CAI.

IMPAC has been involved in the development, implementation, and evaluation of 4 different programs in the 22 schools, with the participation of 111 teachers, grades 4-6.

Computer Managed and Computer-Assisted Instruction

A CMI-CAI program is being conducted to find ways to use microcomputers for basic skills instruction in mathematics, reading, and language arts. Courseware and management software are on a 20 megabyte hard disk networked to 24 micros in the schools; one teacher at each of the grade levels, 4, 5, and 6, has eight microcomputers in the classroom. Instruction is being managed so as to prescribe and monitor the actual lessons taken by the students. Records are kept on student performance and indicate whether specific objectives have been attained.

Computer-Assisted Instruction

This component is similar to the CMI-CAI program except that floppy disk drives are used with stand-alone computers in the classroom; computer-managed instruction plays a less important role. Teacher management and control of access to the computers is crucial in both programs. In most schools, two teachers at each of the grade levels 4, 5, and 6 have four computers in their classrooms.

Microcomputer Basic Skills Laboratories

A lab has been set up in one school district using a network with a 7.5 megabyte hard disk. There are 24 micros in one room; several groups of students come to the lab each day for about 24 minutes of on-task activity. A 30-unit lab with similar equipment has been set up in another district, and functions much the same way.

Basic Skills Testing and Prescriptive Program

Two school districts are implementing an Arkansas Basic Skills Mathematics and Reading Testing Program for the microcomputer. A management system and CAI program are included in the project.

The project has held two writing conferences and developed three in-service course guides that are being used in thirty in-service training centers in the state. A recommended courseware list has been developed and made available to Arkansas schools for use in selecting basic skills courseware including mathematics, reading, language arts, social studies and science. An updated supplement is published every six months.

With anticipated additional funding from the legislature, Project IMPAC expects to add 60 additional schools over the next two years. Then, if all goes as planned, the program will become statewide based on an entitlement formula.

'Computer Skills Next' in Tennessee

Tennessee's legislature captured national attention in 1984 when it enacted its Better Schools Program, establishing a career ladder for teachers and providing $9 million to introduce computer-based instructional programming for 140,000 students in grades 7 and 8. The program emphasizes the notion of "Basic Skills First" as a first priority, said Betty Latture of the state education agency. "'Computer Skills Next' (CSN) follows not far behind in our school improvement plan."

Allocation of funding for the computer program followed a two-year study by a statewide commission. A major concern was providing effective training for about 900 teachers. In one summer, 900 teachers were trained in the fundamentals of the planned course in an intensive, week-long session, followed by a two-day, hands-on workshop.

CSN in Tennessee is a computer literacy course offered in over 600 schools for every 7th and 8th grade student in the state. The curriculum includes the history and social impact of computing, an introduction to programming, word processing, and data bases, and CAI software. About 8,000 single disk computers, with color monitors, were purchased for the program—at a cost of about $730 each. This provides a ratio of about 1 computer for every 20 students. Each elementary school in the state also received a more advanced model to run the Basic Skills management program.

Further, each school received a $500 grant to purchase instructional software of its own choice. Nine support laboratories were set up in developmental districts across the state. There is also a statewide WATS line—it functions like the Help key on many computer keyboards—to provide technical assistance to those who need it.

The program provided $150,000 to establish six software clearinghouses. Each location supports a different subject area: language arts; vocational and fine arts; public domain; mathematics; science and social studies; and administration/school management. The public domain clearinghouse has over 400 programs available at a cost of $2 each for disk and copying.

Tennessee also has adopted a state purchasing contract for computer hardware, making the purchase of equipment simpler and quicker for local districts.

Other features of the new emphasis on high-tech in Tennessee's schools:

- Thirty school systems subscribe to the special education network, SpecialNet, with services ranging from electronic mail to updated national data on special education legislation and programs.
- The State Education Department is manning a microcomputer demonstration lab for both hardware and software in Nashville. Hardware from four major vendors and software from many sources are available to try out.
- As is true of most states in the region, Tennessee is a member of MECC, making even more programs available to the schools.
- Tennessee's Education Department is publishing a technology newsletter, has formulated guidelines for secondary special computer courses, and is developing computerized data collection procedures for special education programs.

Building Electronic Networks

"Telecommunications." It's a word that exemplifies the whole notion of an Information Age, providing for instantaneous access to information, from the library next door or the other side of the globe. Need to examine 100 references in ed psych to gather information on learning theory? Flip on your computer and modem, pick up the phone, and tap into a major data base. The task may be completed in less than an hour, for a cost as low as $10—especially if you have a clear idea of the information you're after. Need to put a 100-page document into the hands of someone on the other side of the continent within the hour? Telecommunications makes the job simple; the document can be transmitted and printed out in elegant style in far less than 60 minutes.

What are the educational possibilities of this rapidly developing technology? In Orlando, conversations were laced with references to networking and the development of other multiuser, multitask systems. And speakers from Maryland and Virginia reported on their states' efforts to link schools in a more effective information-sharing system. Highlights of those presentations:

Maryland's Education Technology Network

Maryland's electronic network, on line in the fall of 1985, will have a pilot program linking the network with eight classrooms. By 1993, planners say, more than 1,000 classrooms will be connected electronically.

The most unusual feature of the Maryland plan is the intent to develop a single standard computer hardware configuration for the state's public schools. "Many standards currently exist for school-based computers used in instruction and instructional support," said Frank Windsor of the state education agency. "Simply put, these standards are not compatible and result in costly duplication of effort in the acquisition of both hardware and software to meet instructional needs."

Maryland is addressing that problem by having personnel of the Education Technology Network (a unit of the state education agency) meet with participating LEAs to review, select, install, and evaluate a computer configuration that will then become the standard for Maryland's schools, K through 12.

The network has four other major objectives:

Staff Development

Opportunities for state level and LEA staff to develop electronic expertise will be fostered through the network.

Software Review

The network and participating LEAs will review, evaluate, and select from existing instructional software and develop new software of its own. Adopting a standard hardware configuration, said Windsor, will encourage the development of original software, since everyone will be writing for the same machine.

Broadcast Technology

The network plans to increase public broadcasting capabilities in Maryland to enable LEAs to receive software and other information via this medium on a metered-use basis.

Consortium

Finally, Maryland plans to establish a multistate consortium to serve as a large base to attract software developers to the education marketplace, "and to allow the economies of hardware and software acquisition possible on a multistate scale," said Windsor.

VNET in Virginia

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IS ANYONE USING DBASEII FOR
STUDENT INFORMATION OR FOR
GENERATING IEP'S FOR SPECIAL ED?
WE COULD USE HELP IN WRITING SOME
COMMAND FILES. ALSO WILLING TO
GIVE ADVICE WHEREVER WE CAN.
THANKS.

WE ARE LOOKING FOR ANY PROGRAMS
THAT DEAL WITH MUSIC SKILLS TO
RUN ON AN APPLE COMPUTER. THIS
IS FOR COLLEGE LEVEL BUT EVEN
ELEMENTARY PROGRAMS WOULD BE
HELPFUL.
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These are typical messages on the Electronic Bulletin Board that is part of the Virginia Network for Educational Technology, a system up and running under the auspices of the State Department of Education since January 1984. Every public school in Virginia has been issued a user ID that permits access to the network's services from 8 a.m. to 8 p.m., Monday through Friday.

The system includes three components: a Bulletin Board, Electronic Mail, and Software Evaluations. The bulletin board is currently restricted to queries and announcements related to educational technology. The electronic mail feature provides for the transmission of private messages, up to 400 characters each, that are accessed by password.

Users of the system are invited to read (or print out) evaluations of software packages or to "upload" (transmit to the system) their own reviews of software programs. The system can contain about 500 reviews of up to 1,000 characters (about 1 typewritten page) each. The system also contains software reviews from MicroSIFT of the Northwest Regional Educational Laboratory.

Managing Electronically: Making Schools Work Better

Schools are complicated places to manage, with untold burdens of scheduling and record keeping—tasks more or less amenable to central control. No one ever asks if such jobs as bus scheduling, grade reporting, managing the school lunchroom, gathering data for state and federal reports, or generating tests are creative or pleasurable. They are generally acknowledged to be king-size headaches that simply have to be done.

Technology is changing school management as profoundly as it is likely to change the instructional process itself. Administrators are finding new satisfaction in their work as they ask the ubiquitous computer to perform drone tasks that are, for humans, arduous and complicated. Computers seem to love them—or at least they rarely complain.

Conferees in Orlando heard a fascinating presentation on the use of the microcomputer as a tool for educators, and they learned about statewide information and record management programs coming online in Florida and North Carolina.

J. R. Pennington, a school principal before he became director of Georgia's Educational Technology Task Force, plays with computers like a kid with a new toy. His fascination with the machines—with what they do and what they can be made to do—is evident and infectious.

As a principal in a small Georgia school, he was anxious to explore the new world of technology. Like many others, he found existing software limiting in many instances and simply unusable in others. Teaching and learning together, he and his school colleagues became "educational hackers"—eventually writing their own programs or modifying others beyond recognition. For an hour and a half in Orlando, he captivated his fellow educators by booting up and running some of these home-grown products. The programs fell into four categories: teacher utilities, administrative uses, instructional uses, and planning.

Pennington's running commentary, as he described his test generation and test scoring programs, went something like this:

"I have a file of questions on this disk that a teacher made several years ago. I'm going to pretend that I'm an American history teacher, and I'm going to generate a test. Perhaps last year I had stored several hundred

questions in a file of my own design. I'd like now to give my students a test.

"The computer comes up and asks what file of questions I'd like to use. I'd like to use a file called 'history.' The computer is going to the disk and loading in only the index to those questions. There are several hundred questions in this file, so it takes a minute or two to randomize the index.

"Then the computer asks, 'What objective would you like to measure with this test?' I'd like to measure objective 34. 'How many questions would you like on your test?' Normally I'd select 15 or 20. Also, last week I taught objective 32; I'll take two questions on that.

"So I simply go through the process of determining what objective I would like to measure, and how many questions on the test will relate to that objective. When I've finished, the computer says, 'How many different test sheets would you like?' This means how many different *forms* of the test do I want to create. If there are 50 questions on the disk about objective 32, and I want 20 on the test, the computer will go in and randomly select 20 from the 50 when it prints the first test. For the next test, it will select different questions. So I end up with equivalent tests, but they will not be identical tests.

"I think some of the teachers, when they began to use this, were surprised that sixth period no longer always scored better than first period. Test validity is an important issue."

Once the test is administered, there's the question of scoring—and another locally concocted program offers a few interesting wrinkles here, as well. "We have a program we call Score and, on the same disk, Score Version 0, that looks just like Score, except the teacher has the opportunity before scoring the test to look at the question he or she has asked the student and say to themselves, 'If the student misses this particular question, what would I like to give that student as a remediation activity, or what would I like to tell the student about the question missed?' You have the choice to load into the computer four lines of information—anything you'd like to say about the particular question—before you score the test. It might be, for example, 'You missed question 1. I'd like you to reread pages 25-26 in the book and work examples 8 and 9 at the end of the chapter, where you will find the answer to this question.' Thus, each student gets a completely unique set of remediation statements as part of their score, based on what they have demonstrated they know or don't know on the test. This can be a very powerful tool in the hands of the teacher who understands instructional design. Just the presence of technology in the hands of the teacher doesn't improve instruction. It perhaps allows new ways and opportunities to improve, but, still, those fundamental teaching skills need to be there."

In like manner, Pennington demonstrated programs that customize recipes in the school lunchroom, make grade and report keeping easier, take care of attendance, and handle other fundamental management concerns. His experience on the school level with these kinds of computerized management tools convinced him that:

- Because they are quicker and more accurate for certain kinds of tasks, computers will save staff time and energy and, in all likelihood, improve morale. "One important and unanswered question: How will we use this additional time that technology will make available for both teachers and administrators?"
- Computers do a better job of record keeping, thus they generally will bring in added revenue simply by keeping better track of what's going on in the school.
- Computers can be extremely useful in establishing and maintaining better relationships with parents and the community in general. It becomes far easier to customize communications with parents, for example, to provide them with more and better information, through the use of technology, about their children's progress in school.

The original or modified materials developed in Georgia are available through the state education agency. *(See Appendix for the names and addresses of presenters).*

Using Technology to Gather and Manage Records

Equity has a high price tag (and, of course, inequity's price tag is even higher). One of the consequences of the public schools' mandate to reach out and serve the educational and social needs of an amazingly diverse group of young people is the layers of accountability that funders—and the general public—impose on the process. The time-energy-effort burden on local district personnel is staggering. Technology opens a door that will dramatically reduce that burden, sharply increase accuracy of tabulations and general

record keeping, and thus, in many cases, bring in more revenue to local districts from funding sources. While perhaps less fun than a computer program that will score 100 tests per second, information and record management programs have a major role to play in public education. Orlando conferees learned about such developing statewide programs in Florida and North Carolina.

Standardization a Key in Florida

Florida's school system will increase the speed and accuracy of its record keeping as it moves toward standardization, Robert Friedman of the state education agency suggested as he described the emerging statewide Education Information Data Base Plan.

The plan, fully implemented, has four goals that are easy to express and far more difficult to achieve:

- build more flexible, integrated data bases at the state level;
- reduce the data burden on school districts through streamlining of reporting;
- promote equitable computing resources and commonly defined information systems at the local level; and
- facilitate more efficient and rapid exchange of information within and between levels of the state education system.

Fully implemented, the plan will consolidate no less than 18 separate reports currently required of LEAs into a single individual student record. Some of the implementation objectives provide a good idea of how the new system will be introduced. Items:

- January 1, 1985—State course numbers were assigned for use in each school district, to be used for reporting purposes July 1 and thereafter. This introduces the key concept of standardizing reporting to permit files to be computerized.
- June 30, 1986—The state-level Student Information Data Base will be operative, integrating state education files currently maintained separately to permit more flexibility in manipulation of data.
- June 30, 1987—Each school system will implement an automated Student Information System, which will include all state-required data elements and procedures for local record keeping, for state reporting, and for the transference of records and transcripts to other school districts and postsecondary institutions.
- July 1, 1987—Individual student reporting will be initiated from local districts to the SEA, replacing current aggregate state reports submitted by school districts. The data will be filed electronically.

Similarly, the plan sets timelines for introduction of staff and financial data base plans.

North Carolina's Five-Year Plan

North Carolina's goals are much like Florida's, but its approach has been quite different. Following a bid process, a computer system consulting firm was retained to develop a five-year plan to introduce automated information gathering and record keeping in the state.

Projects currently underway, said Elsie Brumback of the state education agency, include such fundamental matters as data collection about personnel and certification status of teachers. The first piece of the program to be fully up and running is the Student Information Management Systems (SIMS). It is designed for:

- Pupil record maintenance.
- Class assignment preparation and review.
- Competency test score documentation.
- Attendance and membership reporting.
- Exceptional children records maintenance.
- School administration support including relief of teacher administration workload.
- Basic education program monitoring.
- Special program cost accounting and education results analysis.

Eventually, said the system's director, David Bryant, SIMS files will include classroom-level statistics for students and teachers, ADM and principal's monthly reporting data, annual competency testing results, basic program statistics, exceptional children headcounts, special program reporting, professional personnel activity reporting, and student and master schedules. The SIMS package will be fully integrated—all of these data will be entered only once for all of the functions described.

Two advisory committees have been formed to provide guidance and aid for the SIMS project. The Management Advisory Committee, composed of superintendents, state personnel, university professors, and interest group representatives, provides guidance with general policy. A Steering Committee made up entirely of school principals provides assistance with the details of implementation.

Section Two:

Technology in Tomorrow's Schools

Will it Change the Structure and Functions of Schools?

The "technological revolution" isn't happening in one neat move. Rather, it is fundamentally unpredictable and is likely to remain so for some time (and of course, even that prediction is very uncertain). Planners gazing into their crystal balls foresee advances three to five years into the future. More often than not, the changes occur within a year and may themselves become obsolete as new electronic innovations appear in the marketplace.

One consequence of this technology-bred instability is that it is difficult to predict many of the changes that may occur in public education in the future. "Enlightened" educators, those aware of the currents of change, need to be sensitive and flexible, always prepared to address the learning needs of their students with the most effective tools at hand—but with the knowledge that those tools may change tomorrow.

An important part of the Orlando agenda was to explore the ways technology can be used to do many schooling tasks more quickly, accurately, and efficiently. The validity of the tasks themselves was not, for the most part, the topic of discussion. There were exceptions, however—especially in the remarks of the keynote speaker, Dr. Mary Alice White of Columbia University's Teachers College (her comments, in edited form, are included below). The realization is beginning to emerge, it seems, that technology will not simply supplement the activities of contemporary educators; it will change the teaching/learning process as we know it today. How will that occur? Some ideas surfaced at the Orlando conference:

Individual Instruction of Students

We are just beginning to understand the potential of the computer to interact with one student to promote learning. "With the computer," said Nicholas Hobar of West Virginia, "we will be able to find out, for example, how long it took a student to do a long division problem, where he got stuck, and what patterns and learning styles are evident. You won't have to wait for the student to tell you, or guess."

Military Research

The three main branches of the military are joining resources to study the educational potential of electronic technologies. The thrust of military research is an effort to create learning activities that are designed for individual use, make the learning program as engaging and entertaining as possible, and take full advantage of such technological breakthroughs as voice generation and graphics capabilities in small, portable units.

Ann Leopold of the Army Research Institute demonstrated several products of that research for educators in Orlando:

- CHIP is a computer-based, hand-held instructional prototype that the services are using to increase the reading skills of recruits from the sixth to the ninth grade level—in about six weeks. This highly portable device has many of the qualities of an arcade game. It is designed to be taken into the field. Recruits find it fun to use—and they do so by the hour. CHIP contains voice generation. Testing reading comprehension, it gives the user three choices for each question it asks. When a short series of questions is answered correctly, the program moves on to the next unit. CHIP also has graphics capabilities.
- A vocational education model of CHIP, designed to be taken to the job site, guides recruits through procedures for maintenance of equipment and vehicles. The program includes line drawings of equipment, with zoom capability down to the smallest components—to see how things work and how they fit

together. "Conceivably someone who has never seen a piece of equipment before can be led through troubleshooting maintenance procedures with this device," Leopold said.

CHIP is education in a briefcase. And it works extraordinarily well. When control groups using CHIP and receiving standard classroom instruction were compared, CHIP learners did nearly twice as well as those in the classroom. The military services also are conducting extensive research on educational applications of interactive videodisc instruction, Leopold said.

While CHIP is designed to meet a very specific instructional need of the military, its significance is much broader. As a model for the efficient use of electronic technology to solve specific vocational and remedial instruction problems it has great potential in the public schools.

Greater Flexibility for Teachers

Teachers are becoming more technologically literate—and therefore are demanding more of software and hardware manufacturers. Said Michael Fry of North Carolina, "As we move into tutoring, we will need programs that allow teachers more flexibility in using the computers. A major problem of the past has been the inflexibility of software programs. With the introduction of authoring systems, that liability is coming to an end. Language teachers can use the vocabularies they wish to teach, not just those prescribed in the software."

Preparing for Changes

Educators need to prepare for technological advances that at the moment may be in some hacker's head, but are likely to be in our stores tomorrow. J. R. Pennington of Georgia demonstrated some of those items with educational usefulness. They include: a wristwatch that contains a vocabulary of about 10,000 words in five different languages, which can be used interchangeably; music and voice sythesizers for computers, adding a powerful learning dimension to the machines; computers for less than $100 that can be used to compose music, and calculators not much larger than a postage stamp. This is a modest and limited sampling of the innovations and devices now invading the marketplace, he made clear. What effect will they have on the traditional teaching/learning process in our schools? Will they be recognized as opportunities for learning and therefore be welcomed in the schools, or will there be resistance to the unfamiliar, forcing creative products and the learning that goes with them outside the school domain?

The Role of the Teacher

Where will teachers be, how will they function, in this new school environment that seems destined to be influenced by the electronic technologies? How will teacher training institutions prepare their students to work in this setting? Those questions fuel a lively debate in education. Mary Alice White, who is a director of Columbia's Electronic Learning Laboratory, said she thought "some teachers ought to be put into this future learning environment, and we should ask ourselves: What are the teaching functions? What can kids get from teachers that they can't get from the technology?

"I think schools should be rethinking their curriculum and should be asking themselves: What in the world can we do with schools, going into the information age, that is uniquely educational and that no one else is doing?

"My belief is that there are two important needs. One, children need to be taught how to evaluate the quality of information they receive. Infoglut is going to overwhelm us all; we need to teach kids how to evaluate it. And, two, I think it's time we taught imagery comprehension in the schools. We teach how to read and decode, but I think you have to learn to read and decode images. Imagery is the language of the information age. I would go so far as to say that you cannot make an informed judgment today unless you know how to look at images in an educated way."

White believes institutions of higher education will rapidly become proficient in using the new technology—and that a new level of expertise will find its way into teacher training programs and, eventually, through their graduates, into the public school system. "Teacher training institutions need to be doing much more. At Columbia, we're inventing a future learning environment in which we're going to put all of the technologies in the service of learning. We want to see what learning looks like, what happens to learning when you put in students of different ages in a room with all of the technologies. We start with no assumptions about what the curriculum will be. We ask only: What happens?"

Following are her remarks at the Orlando conference:

Dr. Mary Alice White

The Future of Electronic Learning and the Schools

To set the stage for a look into the future, I'm going to begin by assuming that we were all around in about 1650 in England and that we had the vision to see what was going to happen. We knew the printing press had been invented, and we had seen the Psalter and the Bible printed in vernacular languages. Being full of foresight, we made some predictions:

We predicted that the printing press would enable ordinary mortals to read the sacred Scriptures in their own language. As soon as people had access to the Holy Word, we predicted that there would be a challenge to the authority of the Church. We predicted that somebody would use the printing press to question the interpretations of the Church in Rome and would offer different interpretations of the Scriptures. We predicted, in fact, the emergence of someone like Martin Luther—and the Reformation—which is pretty good predicting.

We also predicted that the development of a printing press and of reading materials would make people want to learn how to read so they could have access to information. This would mean, we anticipated, the development of a system for teaching reading. So we predicted that the common school would be developed, well beyond where it was in 1650, which was not very far. We went on to predict that before long all the children in England would be going to school, not just to learn to read, but to learn to count, and to write. So we predicted the rise of the public school, largely because of the printing press.

We went on to predict that things would not stop there. We thought that if you gave people a little taste of education, they were going to want more. So we predicted the rise of universal education from an early age to adolescence and that all children would be required to attend school at the expense of the state. (This prediction was considered totally ridiculous in 1650.)

Finally, we predicted that, with the development of the public school and the desire on the part of people for more and more information, the level of education would rise over the next few centuries until there would be more students than farmers in an advanced society.

This last prediction came true—in our country—in the 1960s, when, for the *first* time in human history, there were more students in our population than there were farmers. This might help us to understand what happened in the 1960s. Instead of Shay's Rebellion, we had the students' rebellion.

As you can see, we were very bright back in 1650. We predicted the major impact of the printing press. We were right in assuming that it was revolutionary; that it would affect society in the broadest sense; that it would change institutions; that it would cause the emergence of a new one—the public school; and the division and decline of another—the Church in Rome. We learned from that lesson that once people have access to information, there is no way of turning back. Access to information may be the most important political tool that people can have.

For those of you who may have read Barbara Tuchman's most recent book, *The March of Folly*, you will recognize that our predictions were not shared by a series of Popes in Rome. They made some pretty

dreadful mistakes by not understanding what was happening. They made five mistakes that have some special meaning for us today as educators:

First, they did not recognize the invention of the printing press.

Second, they did not see the vast implications that the printing press would have across society.

Third, they did not see the impact of the printing press on their own institution—that of the Church in Rome.

Fourth, they did not anticipate the implications for the loss of power of their own institution.

Fifth, they did not develop a positive plan to maintain a leadership position.

I am going to argue today that educational leaders face some of the same problems that the Popes faced in the 16th century with the arrival of the printing press. This time the schools are faced with the development of new information technologies which are going to have, I believe, a very great impact on our society.

Having had the benefit of historical hindsight with respect to the experiences of 1650, I am going to stick my neck out and make six predictions about the development of the new information technologies—by which I mean not just the computer, but videotape, videodisc, computer-driven videotape, networking, electronic mail, and so forth. I predict that these new information technologies will:

1) *alter the fundamental nature of the learning process;*
2) *provide a new learning system and require a new psychology of learning;*
3) *alter the content of what is learned;*
4) *provide an alternative educational environment;*
5) *provide a learning environment in which almost anyone will be able to learn almost anything; and*
6) *provide a curriculum of individual choice in which the individual will choose* what *to learn,* where *to learn,* when *to learn, and* how *to learn.*

If these predictions prove at all accurate, they will bring with them some problems, obviously. I would like to look at these problems from the point of view of an educator, ignoring for a moment some of the legal and political implications. Four problems that I see will be:

Problem #1

Schools will lack an articulated curriculum. I see the development of a curriculum at home, and the other at school, and they may or may not prove to be compatible.

Problem #2

The way in which our schools currently are organized probably will become unworkable and will need to be reconceptualized. Our schools are organized by age (which is what a grade means) on the assumption that the material is being learned for the first time by the pupils. Our curriculum reflects the belief that certain things are appropriate for first graders, and others for eighth graders—a belief based on the assumption that this is the first major contact that the child has with that material. If that assumption is wrong, as I think it well might be with home learning, then we must ask: how *should* we organize a school in which children of the same age are going to bring an enormous range of knowledge of the same school subject?

"Today, all the new technologies are in competition with the schools. Furthermore, they are competitive with respect to every aspect of the schooling process."

Problem #3

The third problem will confront the teachers. For they, if we keep the graded system, will be asked to teach standard material to pupils of the same age, despite those pupils' widely different levels of competence. (Indeed, they are being asked to do that right now.) What in the world is a teacher going to *do* with that situation? Will the teacher become an information manager—whatever that is?

Problem #4

The fourth major problem will be that the schools will no longer control access to the skills and knowledge essential for an educated citizen and worker. This is probably the most profound change of all. It strikes at the basic assumptions of the public schools. What happens to schools when they no longer have a monopoly on access to learning? Will they find themselves in a historical parallel to that of the Popes who no longer controlled access to the sacred Scriptures?

The beginning of the loss of control over access to learning started some time ago, although I do not think we recognized it. It began a bit with the radio, but it certainly took off with the widespread installation of television in the 1950s. We, as educators, *never* saw television for what it is, which is not a wasteland, not just an entertainment system, but actually *a second educational*

"It may be that the really crucial educational problem confronting us and our children is 'infoglut'."

system. It meant that schools no longer controlled access to information. Children could turn to the television for access to certain kinds of information. This meant that the schools had a competitor. That was only the beginning.

Today, *all* the new technologies are in competition *with the schools*. Furthermore, they are competitive with respect to every aspect of the schooling process: in content, in how to teach, in how to make learning fun, in how to motivate the learner, and in providing social interaction among children that is learning centered (which some software now *does* provide). But most of all, the technologies challenge some basic assumptions in public schooling today. They compete with schools by offering the option of learning by individual choice, as opposed to learning in a group setting, at group pace, and by grade.

We, as educators, failed to see television for what it was. It sneaked into our living rooms as mere entertainment and has turned into an alternative information system. And the *new* technologies are going to turn learning into a combination of education and entertainment.

All of this happens at a time when schools are weathering a period of intense criticism. In my view, one set of criticisms has come from comparing television with school, and this has come from the children. They have found that learning from television is fun and, by comparison, they find school boring at times.

Another set of criticisms has come because we are the most educated society the world has ever known. No society *anywhere* in the history of man has been as educated as the United States' society today. The more society is educated, the more likely it is to criticize its educational system. Everybody is an expert on education—even though we do not agree on what is good education! That is not going to go away. The more educated we become, the more likely that education will be a major focus of debate, and I think this is rather healthy. But, the era into which I see us going is one in which the schools are going to be facing increasing competition from alternative learning environments. At the same time, education will still be increasing in our society, so schools are likely to come under still more competition and criticism. I am sorry to have to say that, but I think it is accurate.

What then should school leadership do, faced with this prospect of a rival in learning at home? Mind you, I did not say it was a rival in teaching—but I *did* say it was a rival in learning, and a growing one, and in a society that is highly educated. I think school leadership today might take a lesson from what happened to those 17th century Popes and do several things.

◆ ***First,*** school leaders need to develop a *very broad* picture of the change that all the technologies will bring, and, by all, I mean not focusing exclusively on the computer. Within a year or so, I am reasonably sure we will be seeing computer-driven videodisc as well as computer-driven videotape, and if we do not anticipate that change, we will be caught with *our* computer terminals down.

This year, there are expected to be *twenty million* VCRs (video cassette recorders) in the homes in this country—at least *twice* as many as there are computers. VCR sales this year are up 78 percent, computer sales, 10 percent. People are being entertained and being educated by video cassettes right now. This might suggest to school leaders that we should pay attention to *that* technology. It is a wonderful medium for modeling, if we are interested in modeling behavior, and, as educators, I think that is one of our primary goals. We will see a rise in networking and in electronic mail.

So, the first job as I see it, is to develop a *broad* picture of the future of all the technologies. It is often pointed out that technology is adopted in ways that are unexpected by the ones who invent it. I was told recently that there are two large groups of users for the Tandy-100 portable computer. Journalists make up the first large user group, for reasons which we all would expect. Those in the second largest group like the computer's portability and its speed of computation, and they are great admirers of the speed with which the data can be dumped—they are bookies.

◆ ***Second,*** I think that, unlike the Popes, we as educators should seek an understanding of what this technology will mean in terms of social change. It certainly will affect the work place as well as the home; it probably will affect commercial establishments (some already have installed videodiscs). It will affect what we want to learn and how we want to learn. It will put more and more information into the hands of people—a trend with profound political implications.

◆ ***Third,*** I think that we have to recognize how these new technologies will impact upon the

"We, as educators, failed to see television for what it was. It sneaked into our living rooms as mere entertainment and has turned into an alternative information system."

schools. I have already indicated that I think they will change the role of school in society: The school will no longer be the controller of the access to learning—it will be only *one* of the doors to learning. I think we need new ideas about how to organize schools. And we need them soon—before it happens to us.

- ***Fourth,*** given these changes, we obviously will need a new understanding of what teachers should be doing. If we were very smart, I think we would be experimenting *now* with new teaching functions for the new technological environment.
- ***Fifth,*** we will need articulation between what is being learned at home and what is being learned at school.
- ***Sixth,*** I think schools need to develop a positive plan to survive *with*—and *by*—the new technologies.

Let me make very clear what my values are about schools. I care very much indeed about the survival of the public school system. A democracy without a public school system would be in very serious trouble. I want to see the public school continue as a healthy, lively institution. In order to do so, I believe schools must become much *more imaginative* about what they do in the new learning society that is different from what they are doing right now.

It will not be enough to buy some computers. It will not be enough to set up a computer resource room or laboratory. Computer literacy will fade out very quickly. In fact, computers will be only a small part of the picture of what is coming. So, in addition to my predictions, I would like to offer some suggestions for what the educational leadership could be doing to meet the electronic learning revolution.

Suggestion #1

First, I suggest that we recognize that the school market is a very small part of the software market and therefore does not have much clout. Textbook manufacturers are not terribly interested in producing a lot of software for fear they may hurt their sales of their textbooks. People who design software for the home are not very concerned with the school market, which may represent 10-30 percent of the total software market. What are schools to do? One obvious thing the schools *could* be doing is to join together within states and across states—to put their purchasing power together so as to influence the standards of software and hardware being designed. Parents would welcome activity on the part of schools in setting some standards.

You and I know that some software is very good, and a lot of software is not very good. This is a logical place for the schools to assert what they know, which is whether or not this particular piece of software is likely to help a child with this particular subject in the school curriculum. It would establish the schools as an institution that cared about technology in a meaningful way for parents and consumers.

Suggestion #2

Schools must make up their minds about what they are going to do with the technologies. I am sure you have heard advocates of many points of view, so I will advocate my own opinion on this. I think computer literacy does not belong in schools, if by that you mean teaching children how to use unusable machines. The computer industry should not ask the schools to do their job for them. Industry should be designing machines that are as easy to use as television (which all children from age 4 can operate in about 15 seconds). Precious school time and resources should not be spent to teach people how to use poorly designed tools. I also do not see much point in teaching programming languages, except for those few students who want to learn them. I do not think you should have to know a programming language to use a computer as a learning tool.

At the present time (and this may change quickly), I see computers being used as a learning tool primarily in one area, and that is as a word processing tool. Computers are superb writing tools. If I were running a school today, that would

be where I would put my money. I would encourage parents to buy appropriate word processing hardware and software for the home. I would encourage word processing in school in every part of the curriculum. I would encourage teachers to encourage pupils to write with a computer. I would spend money to get computers into the school, and I would make them available to parents after school. In short, I would do anything and everything I could to say, "Here is a useful learning tool. It is called word processing, but what it is, is an electronic finger that helps you to write." If I were a superintendent or a member of a state education agency, I would be using a word processor in my office.

Suggestion #3

Educational leaders, through an association, should be setting up study committees on videotape, videodisc, and videotext—to anticipate how they will be used at home and how they might be used in school. Committees should be studying networking, electronic mail, and the use of data bases at home, at school, and at work, and they should be making recommendations and carrying out *trials*. We cannot lead without information, and information has to be up-to-date. If I were running a school system, I would be doing my best to anticipate what will happen, deciding which of the technologies (or all of the them) could be used at school and at home. I would be changing my thinking from looking at school in a narrow way to looking at learning in a broad way.

"Computers are superb writing tools. If I were running a school today, that would be where I would put my money."

I must confess that I worry a lot about what could happen in the future if certain scenarios unfold. I can imagine technology moving into homes, into libraries, into museums—because it already is moving there. I can see educational technology moving into shopping centers, into public parks, into stores—because it already is moving there.

I can see education moving out of the public schools in this scenario. If this happens, education will no longer be the school's major function.

I worry that schools are reacting to these educational technologies as though they were just another subject to be learned, such as a computer language or computer literacy. Some schools seem to be responding to a technological revolution by trying to absorb it into the traditional curriculum.

I worry that we educators are not asking the right questions. Too many of us are asking, How can we box this innovation into another course? Another credit? Another class period?

The questions we should be asking are more difficult to answer because they demand that we reexamine our basic assumptions about schools and learning.

The questions I think educational leaders should address—hopefully in association with other educational leaders—are questions such as this:

- When people can learn a wide variety of subjects at home through a combination of technologies such as computer, videotape, videodisc, and networking with peers, then what is the *school's job* going to be?
- Since children cannot stay home because their parents are now both working (60 percent of mothers with children under 6 years old are now at work), they must go *somewhere* during the day and presumably that somewhere will be school. Question: How is the school going to be something more than an unattractive alternative to children who have access to entertaining learning technologies at home?
- What would learning *look* like if we put the power of the technologies to work for the learner?
- What would a technological learning environment look like? (You will notice I did not use the term "classroom.")
- What should learners have in common who come together to learn with these technologies? Or—*Should* they come together? Do we need a "help" function as a *live* person in the room or a live person at the end of a communications network?
- What will be the learner's view of reality when the learner moves from learning from speech, to print, to hands-on experience, to simulations that represent a more abstract conception of reality? What happens when the direct experience and the simulation give conflicting perceptions of reality?
- How do learners deal with a broad flow of data which varies in accuracy, relevance, and conciseness?

"What would learning look like if we put the power of the technologies to work for the learner?"

These are fundamental questions. *Fundamental questions are what you ask about a revolution.* If we do not ask such fundamental questions, we will not ask the right questions. If we do not ask the right questions, we will make the terrible mistake of trying to confine radical change in little boxes. The boxes will never hold it. The learning revolution will escape those little boxes. It will go out into the home and the museums and the libraries and public places, and it will leave the schools. If that happens, the public school system will become a day

care center for people who are five to eighteen years of age. That makes me worry.

And I worry about software being developed by the private sector without any participation by a public agency or representative who will ask: Is this appropriate education? or good education? or desirable education? or does it make sense in the head of an eight-year-old?

I worry about who will be able to afford these learning technologies and the software, and who will not.

But—I also am excited and thrilled when I see learning with the new technologies that is responsive to the learner's pace; that is under the learner's control; that is interactive; that is fun to use; and that is full of images. This is what learning could be like, and it is very exciting. What a wonderful place school *could* be!

We are no longer the school that was invented because of a printing press. Pupils will have choices that they did not have before. When people have choices, they make comparisons. When they make comparisons, some options are going to come off well, and some are not. As an educator, I would have to say that the institution we call schools will have to change if it is to survive in a meaningful way. It could survive in a nonmeaningful way as a place for children to go while their parents are at work, but I don't think you and I are interested in that.

For schools—and by schools here I don't mean just K-12 schools. I mean colleges and graduate schools and schools of education—are clearly going to have to change to be an attractive alternative to what people will be able to get on their own. Why should a student come to my school of education at a great deal of trouble and expense (be unable to park her car and pay what she feels is a great deal of money) for a course in which she sits and listens to somebody talk? In 1985 that does not make a whole lot of sense.

All of us educators have glue in our heads about the great value of having people listen to us talk, which I am illustrating at this very moment. What the new technologies say to me is that there are many different ways to learn. People can learn from hearing someone talk, yes, but they also can learn in a game format, and they can learn through manipulation, they can learn through all kinds of interactivity, and they can learn extremely well through images.

All of this leads me, as an educator, to recognize that the school is not going to control the access to learning in the future. In fact, it does not today.

School leaders might well ask themselves: What is our unique educational role in the middle of an electronic revolution? What can we do in the schools that is consistent with our institution and yet makes a different contribution?

"I would like to see our schools have the wit, the imagination, the intelligence, and the courage to anticipate, to predict, and to plan."

It may be that the really crucial educational problem confronting us and our children is "infoglut."

Educational leaders could be asking themselves, "What are the skills that people are going to need as they move into an age of learning through the new technologies?" Should school be the place where one learns how to evaluate the *quality* of information? Should school be the place where we learn how to organize information for memory storage and how to retrieve it? Should school be the place where we learn to cope with an overwhelming amount of information?

I think the answer to those questions is "yes." Schools should be defining and teaching the skills required to handle "infoglut."

One skill that will be needed is the ability to evaluate the quality of information. A second skill that already is needed is the ability to analyze images. *Imagery is the new language of the information age.* It is also the dominant language in our political life. It is crucial that our children learn how to decode images, as information carriers, just as they learn how to decode print. This is a job for the schools that is begging for initiative.

I am teaching a course in Electronic Imagery this year, for the first time, at Teachers College, and these are some of the questions and worries that are on my mind. It is tough going because it makes me rethink all my assumptions about education and schooling. I have to ask myself *which* of these skills and knowledge areas can best be learned using the technologies? Which of these has to be learned face to face with an instructor? What can this technology do better than I, as a teacher, can do? What can I do that is better than this technology? I am asking these questions, and I hope you are. If we don't ask these questions and if we don't develop some way of understanding what is happening to all of us, and to our schools in particular, I think we are going to be bypassed. *The schools are running out of time.*

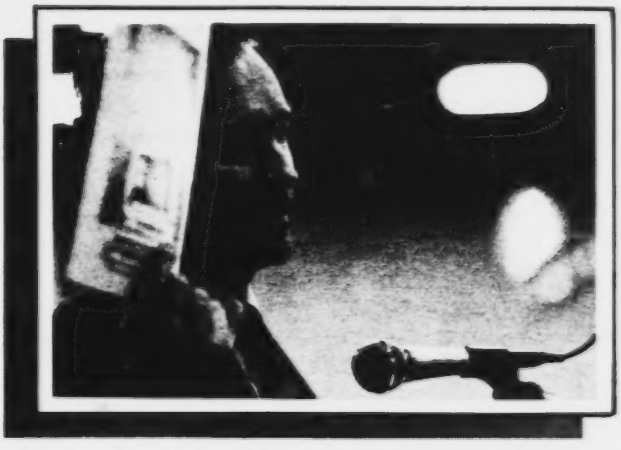
The worst thing that could happen is for schools to see only the hardware, the gimmicks, the hoopla—to be blind to the broad social change affecting all aspects of our society, but particularly the school, and to avoid thinking about how the school should change itself. If we don't change intelligently, I think we will repeat the message of the 17th century. We will be forced into an Educational Reformation. Maybe that is inevitable. But I would like to see our schools have the wit, the imagination, the intelligence, and the courage to anticipate, to predict, and to plan.

The Challenges of Staff Development

A poignant question lingers from the 1960s: "What if they gave a war and nobody came?" In the 1980s we might ask, "What if technology offered opportunities to revolutionize schools and teaching and learning—and no one paid much attention?"

That "no one" has to mean teachers, because it is teachers who are key factors in the teaching/learning process. Of all the topics that swirled around the three-day gathering in Orlando, none commanded more energy and attention than this: How do we help teachers to understand and use these new electronic tools with enthusiasm and success? Efforts to enrich and expand programs in teacher training institutions are important, of course—but given the reality that 80 percent of today's teachers will still be in the classroom ten years from now, the fundamental job is one of in-service training and staff development. Those who spoke on the topic in Orlando made it clear that approaches and mandates vary from state to state—but a common theme that emerges is that using technology itself may prove to be the best way of all to involve teachers in the instructional applications of technology.

Kenneth McGill of the Virginia state education agency described the Commonwealth's approach: a task force defined three levels of ability in educational computing, basic literacy, utilization in instruction, and specialization. "We decided that by 1986 every teacher in Virginia should have level one training—a 16-hour program with 13 specific objectives. Then the question was, how are we to provide this kind of training to 65,000 instructional personnel in 1,700 schools and 140 different school divisions by 1986? The answer certainly was to use the technology, so we decided to use instructional TV. With some limited funding provided by the legislature, we developed and produced a 16-program series around level one objectives." These programs are 30 minutes long; the 16 hours provide one continuing education credit.



The "utilization in instruction" level of competency in Virginia is for educators who will be using computers as instructional and management tools. A minimum of 45 hours of instruction or equivalent experience and study is required to attain this level; effective use of a program language is necessary, as well. The "specialization" level is for teachers who want special purpose training. The idea is to develop people with specialities who can serve as resources in different areas, such as programming languages, developing and using instructional software, and developing data base systems. A state agency goal is that between 5 and 10 percent of the educators in Virginia be qualified in at least one area of specialization by 1988.

In Florida, said Doris Nabi, the Office of Teacher Education coordinates the master in-service plans for the local districts and also coordinates a series of summer institutes for teachers. In 1984-85, the office administered a $9 million program to provide teacher training in math, science, and computer education. "This exemplifies the commitment Florida has made to institutionalize technology in our school districts," she said. Further, different bureaus and offices within the state education agency have staff development programs that often include gaining proficiency in computer technology. There is also a statewide system for evaluation of special education software.

Robert Reese in South Carolina, part of the Office of Instructional Technology that includes instructional television and radio, has been busy, providing three-hour computer workshops for teachers, especially those who teach grades one through eight. He and five colleagues share responsibility to reach out to the state's 34,000 teachers in 1,000 schools. Included in their activities have been establishing guidelines for the purchase of instructional software in mathematics and language arts. A "blue-ribbon" committee of teachers studied countless software reviews as part of that process. While evaluations indicate the workshops have been successful, Reese said that he and staff members are increasingly turning to use of the state educational communications system to do this instructional work.

The Question of Copyright

Some educators may get their hands slapped if they don't get them out of the cookie jar, Shirley McCandless of the Louisiana state education agency warned. Anxious to find effective educational materials for their students, many educators are copying computer software programs—often unknowingly breaking the law. Part of the problem is that there has not been a definitive court case expressing clear guidelines for educators.

The expert advice offered in Orlando was simple: If in doubt, don't do it. It's probably illegal.

"There's going to be a test case coming very quickly," McCandless said, "and I don't want it to involve anyone in my state. Or, hopefully, in yours." In the Southeast, only Louisiana, she said, has state laws dealing with copyright.

It is a matter of finding a solution to a major headache for the computer industry, she said. In the coming school year, public schools will spend $13.5 billion on educational software. And while this is a sizable chunk of business, dealing with the education community, said McCandless, "is like stepping into a Louisiana bayou swamp. You need to hear the nightmares, the horror stories, that publishers and developers [of software] are going through—issues of backup copies, multiple disks, networking, licensing, and on and on. It's just a matter of time before it all ends up in court." Seeking to be helpful, the International Council for Computers in Education has issued a statement on network and multiple machine software asking that:

- "Educators . . . face the legal and ethical issues involved in copyright laws and publisher license agreements and . . . accept the responsibility for enforcing adherence to these laws and agreements. Budget constraints do not excuse illegal use of software.
- "Hardware vendors . . . assist educators in making maximum cost-effective use of the hardware and help in enforcing software copyright laws and license agreements.
- "Software developers and their agents . . . share responsibility for helping educators observe copyright laws and publishers' license agreements by developing sales and pricing policies."

Gary Becker, a consultant in the field, described the situation in different language: "We've mixed educational rationale and the law. Educational rationale is that we don't have sufficient budgets to deal with these things—if we buy one copy, we certainly, legitimately must be able to reproduce it. The problem is that this doesn't hold up in court.

"'Who's going to catch me?' you ask. 'What are the odds? What are they going to do to me?' It's a moral predicament in education. What kind of model do we want to present to our students?"

Educators also "need to be aware of the difference between licensing and purchase. If you license a piece of software and they tell you it can be run on an Apple computer while hanging over I-95 on a bridge at 3 o'clock in the morning on machine number 6005—that's the only way you can use it, folks. So if you sign licensing agreements, please be aware that you are obligated to the license, and copyright doesn't hold."

There are other tricky, unresolved issues. If a teacher writes a piece of software and is using it in her classes, who owns it, the teacher or the school system? What if the teacher wrote it at home, but did the work on a computer borrowed from school?

As they say in the high-tech age, stay tuned for further developments. "All policies regarding technology are cast in jello," commented presenter Leroy Fink. What we believe is true today may well prove to be something quite different tomorrow. The Southeastern Regional Council for Educational Improvement will continue to assist educators in threading their way through the thorny thicket of computer copyright law.

In sum, the copyright issue is both difficult and complicated for educators, and it seems essential that SEAs provide leadership to ensure that legal requirements are fulfilled. It is also certain that the copyright issue, still being defined, will become increasingly important for public education in the years immediately ahead. The Orlando conference began the process of charting waters which are clearly full of shoals.

Conclusions:

Three Paths for Educators

The Orlando conference on using electronic technology in the schools dealt with the details of many topics and in so doing, gave shape and subtance to three major themes:

◆ It is true that a sizable portion of the educational establishment has its heels in the sand when it comes to using and understanding the educational potential of electronic technologies. Repeated surveys, for example, have indicated little movement on this issue in teacher training institutions across the country. The reasons this is so are many; the consequences are that vast learning opportunities are being developed for learners of all ages with limited involvement of schools and educators. The Orlando conferees, by their presence and their participation, made a clear statement that they believe in a full exploration of the creative and effective uses of electronic technologies in the instructional process and in school management activities.

◆ It perhaps is true to say that of those who are excited about the potential of computers and other electronic devices to assist in the teaching/learning process, a substantial majority see these machines as tools to make today's curriculum—and today's schools—work even better. This point of view was clearly expressed by one conference participant, who rose to say, "Certainly I intend to use computers to assist with the instructional process—I can see the clear advantages in doing so. But I don't for one second plan to change my curriculum to accommodate the computer. The computer will serve me and the students. We will not serve the computer."

◆ Finally, there is a third group—in Orlando, Mary Alice White was their chief spokesperson—who believe the technology will indeed change the curriculum—and a good deal more about public education. It will change—it already is doing so—the way people think, the way they collect information, process it and use it. It introduces a wholly different approach to learning than the linear, sequential pattern of the print-dominated age. People like White, and many others in Orlando, have no interest in promoting technology. But they believe technology, powerful as it is, will push educators to ask, again and again: What is the purpose of education? What can we do in education to fulfill that purpose for our students?

As the Southeastern Regional Council's Executive Director Charles Law said in closing comments at the conference, "When we are ready to deal with that question of purpose, then the questions of the shape and content of our curricula and the use of technology will be simple problems with self-evident answers."

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